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AUTOMATIC DERAILING SWITCH AT ROSLYN NO. 3 MINE NORTHWESTERN IMPROVEMENT COMPANY, ROSLYN, WASH.

BY

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AUTOMATIC DERAILING SWITCH AT ROSLYN, WASH.[1]

By S. H. Ash[2] and Rudolf H. Kudlich[3]

The description and attached sketch of an automatic electrically operated derailing switch are based on data furnished through the courtesy of Mr. Thomas Murphy, superintendent of the Northwestern Improvement Co.'s mines in the Roslyn field, Washington, and of Mr. E. M. Brooks, chief electrician of the same company, who designed and installed the apparatus.

The switch is installed on the slope joining the mine and the tipple a short distance above the tipple landing of the Roslyn No. 3 mine of the Northwestern Improvement Co. at Roslyn, Wash., and is for the purpose of derailing runaway trips, and thus preventing injury to the employees on the tipple, or property damage as a result of such occurrences. The device has proved so successful that the company has adopted it as standard equipment and will install it at all of its mines.

The mine cars are handled by rope haulage from the slope to the tipple in 30 car trips; the power is supplied by an electric hoist located underground and at the top of the main hoisting slope. The haulageway from the hoist to the tipple is about 3,000 feet long and consists of about 2,000 feet of rock tunnel with its portal located approximately 1,000 feet from the tipple. The grade to the tipple is from 4 to 8°. In dropping the loaded cars to the tipple, part of the trip occasionally breaks away, and if not derailed in some manner the runaway cars would go through the tipple. Since frequently only a part of the cars in the trip break away, the engineer is not always aware that a runaway has occurred, and manual control of the derailing switch can not be relied upon. With the arrangement herein described the switch is always thrown for the derailment track, and is automatically lined up for the tipple when the trip, if under normal control, reaches a point about 300 feet above the tipple. Should part or all of the trip become detached from the hoisting rope, the runaway trip would reach the derailing switch before it was closed by the automatic device and would be derailed.

The apparatus controlling the derailing switch consists of a controller mounted on

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the hoist indicator and operated by it; an electrohydraulic operating device at the switch; and pilot lights at the hoist, along the slope, and at the tipple which indicate at all times to the hoist engineer, the rope rider, and the tipple crew the position of the switch. The arrangement and wiring of the apparatus are shown diagrammatically in Figure 1.

The controller (fig. 3) is actuated by the hoist indicator and controls the switch-operating device, causing it to open or close the derailing switch when the trip has reached a certain predetermined point (300 feet above the tipple). It consists essentially of a double throw switch, actuated through a pin and jaw device by the hoist indicator pointer, which makes or breaks the control circuit leading to the electromagnetic reversing switch controlling the hydraulic track-switch operating device. A pin on the hoist indicator pointer engaging the forked end of the contactor arm causes the upper end of the arm to move from left to right or from right to left as the trip approaches or leaves the tipple. A contact pin mounted on the upper end of the arm, but insulated from it, bridges a pair of contact strips and completes one or the other of the control circuits. These circuits actuate the reversing switch.

The reversing switch (fig. 1), mounted near the hydraulic track switch, is a three-pole double throw switch operated by solenoids and having a no-voltage release. The solenoids, connected in the control circuits, throw the switch which governs the direction of rotation of a pump motor which is part of the track-switch operating device. The no-voltage release coils function somewhat like limit switches by being connected through relief valves (fig. 2) on the operating device.

The operating device consists of a piston having its rod connected to the track-switch bridle bar and moved from one end of its cylinder to the other by hydraulic pressure developed by a reversible motor-driven pump in closed circuit with a cylinder having its ports connected one to either end of the cylinder. Pump, cylinder, and piping are immersed in an oil-filled tank, the oil being the hydraulic medium. When the track switch reaches the end of its travel in either the open or closed position or when the mechanism jams, the oil escapes through the relief valve and oil to make up this wastage is drawn in through a check valve on the pump intake.

The relief valves (fig. 2) are spring-loaded to a pressure sufficient to break the track-switch points loose after standing overnight but insufficient to overtax the pump motor or mechanism. (This was found by trial to be an actual thrust of about 300 pounds at the switch points.) When the switch points reach their limit of travel, pressure in the working end of the cylinder increases, the relief valve at that end opens, and the escaping oil forces out a plunger in the discharge pipe. The plunger is held in its normal position by a high spring which exerts just enough pressure to make good contact between an insulated bridge mounted on the projecting end of the plunger and terminal points in the no-voltage release circuit of the reversing switch. A 1/16-inch hole in the wall of the discharge pipe, exposed when the plunger is in the normal position, allows any oil leaking past the relief valve to escape without pushing out the plunger. A second larger hole, exposed only when the plunger is extended, allows the escape of the full discharge of the pump, if the pump has not stopped running by the time the plunger has been extended to the limit.

A push button station located at the switch, having two buttons for "tipple" and "derail" respectively, provides for the working of the switch by means of the operating device, regardless of the automatic control at the hoist. In case either of these buttons

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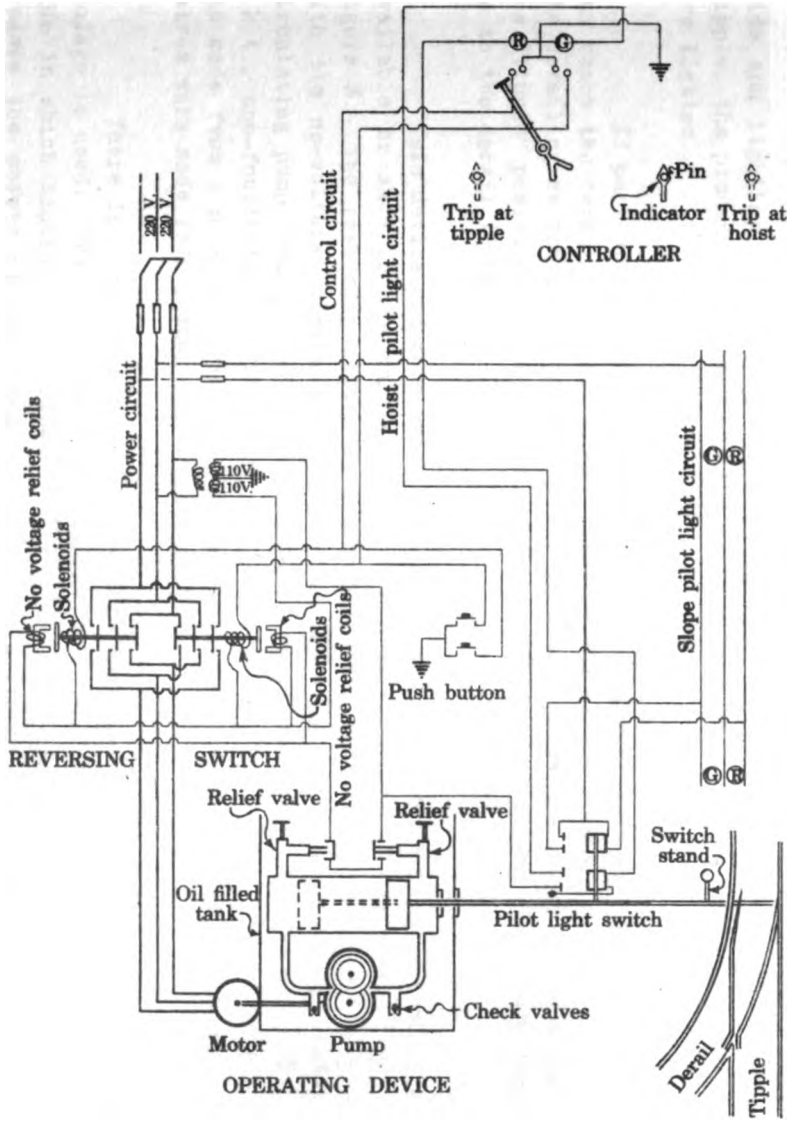

Figure 1. – General diagram of safety device for use where haulage is on slopes

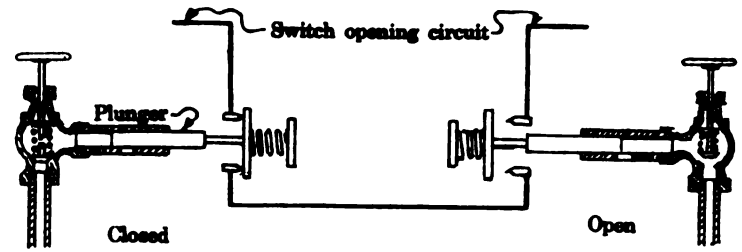

Figure 2. – Detail of relief valves

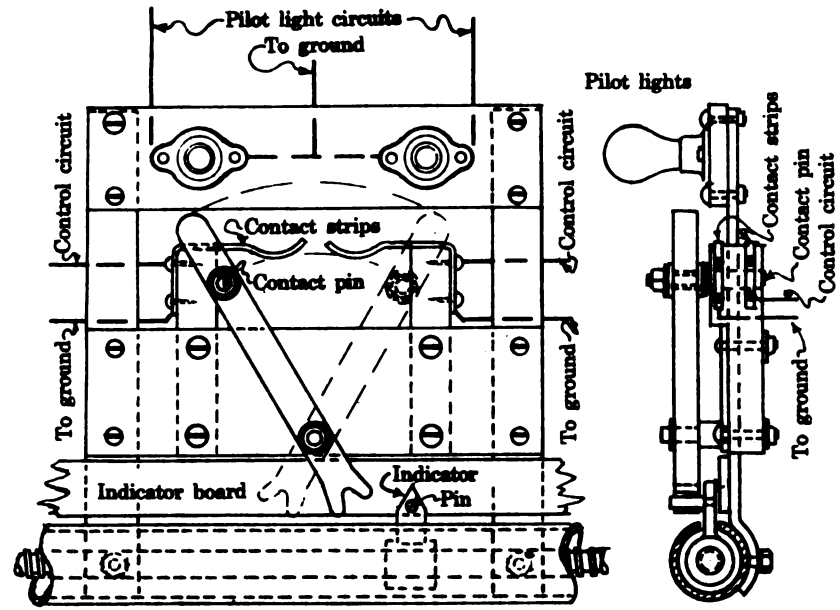

Figure 3. – Detail of controller

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is closed, the indicating lamps and entire mechanism operate as when controlled by the indicator attachment. It is impossible then to operate the switch from any other position until the button control switch is open. By disconnecting the piston rod from the switch bridle, the switch may be thrown by hand. An ordinary weighted, hand lever-switch stand is provided, the lever weight tending to hold the switch points in the normal (derailing) position.

Pilot lights along the slope, at the hoist, and at the tipple are controlled by a switch linked to the track-switch bridle so as to show red when the switch is set for the derail and turn to green as the switch is thrown for the tipple.

Current is taken directly from the 220-volt three-phase power circuit for the track-switch operating device and for the pilot lights along the slope and at the tipple. For the control circuits and pilot light at the hoist, it is stepped down through a 200-watt insulating transformer to 110 to 220 volts with the middle point grounded.

The device operates in the following manner when a trip is being lowered and approaches the derail switch under normal conditions. The indicator pointer moving from right to left (fig. 1) throws the contactor arm over so as to bridge the contacts at the right. This closes the "tipple" control circuit, draws the armature of the reversing switch to the right and starts the motor in the proper direction to pump oil from the left hand end of the cylinder to the right forcing the piston to the left and setting the track for the tipple. When the switch is closed, excess pressure builds up in the cylinder, the relief valve on the loaded end of the cylinder opens, the plunger is forced out and the circuit broken. This causes the no-voltage release coil to become dead and the power switch to open. Meanwhile the pilot light switch is being thrown to the left; closing the circuits on that side and lighting the green pilot lights. As the empty trip is being hoisted from the tipple, the procedure is reversed; the track switch is thrown to "derail" and the red lamps are lighted.

If part or all of the trip should part from the hoisting rope, it would gain speed and reach the derailing switch sooner than the end of the rope being paid out by the hoist. The derailing switch is controlled by the hoist and therefore would not have been thrown to the "tipple" position by the time the runaway trip reached it and would turn the trip aside on to the derail track.

This device was made and installed by colliery electricians from materials readily available or made in the colliery shop. The construction of the controller is seen in Figure 3. The reversing switch is a standard type magnetic three-phase reversing switch with its no-voltage release coils connected in a separate circuit. The pump is an oil circulating pump from a Chevrolet automobile, direct-connected to a General Electric type r.k.t., one-fourth hp., 1,725 r.p.m., 220-volt three-phase motor. The operating cylinder was made from a sleeve bearing casting and is 2½-inch bore by 4½-inch stroke. The relief valves were made from ¼-inch angle globe valves.

There is a definite need for a reliable automatic derailing device wherever slope haulage is used. The device described is worthy of consideration of the officials of every mine in which hauling is on slopes. The adoption of an automatic derailer not only increases the safety of employees, but it also increases the economic operation of slope haulage by decreasing property damage.

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